SPACE SCIENCES LABORATORY

TECHNOLOGIES TRANSFER:

A CONTEXT FOR POLICY CONSIDERATION

by

Todd R. La Porte

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Assistant Professor
Department of Political Science

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A Context for Policy Consideration

As a body of citizens and public officials, our nation has developed an enormous enthusiasm for the uses of scientific technologies in the solution to public problems. Recently this enthusiasm has been focused upon our urban scene in seeming desperate hopes that technology can somehow help us break out of the apparent pathway to social disaster we amble along. Our slightly shrill insistence upon exploring technological development or transfer from space and defense technologies seems cast, however, in a perspective far too narrow for positive long-range outcomes. This paper is addressed to the problem of the context in which serious consideration of transferring technologies from other sectors into the urban environment could be carried on.

At the outset, there is no need to belabor the point that science and technology have had a staggering impact on social life generally. These effects are so pervasive that it is often difficult to see how it might be otherwise. Let me assert a basic assumption concerning these matters.

> The enterprises of science and their associated technologies are the primary determinants of change in our culture, especially in contemporary politics; and the major vehicles effecting change are economic and governmental institutions.

At this point a brief distinction between science and technology is in order. I am sure all of you recognize it, but our propensity to confuse the two suggests it needs re-enforcing.[1] Science, in the broad sense, is composed of those activities and people associated with the study of physical, biological, social and individual behavior within the canons of scientific method, however you care to understand that term. The aim is understanding, not application. Technology, on the other hand, is the application of scientific knowledge to the solution of socially or economically defined problems; that is, the use of scientific knowledge for social purpose. In general, the technical professions are the social organizations associated with technology, including engineering, medicine, architecture, and, in less rigorous ways, law and education.

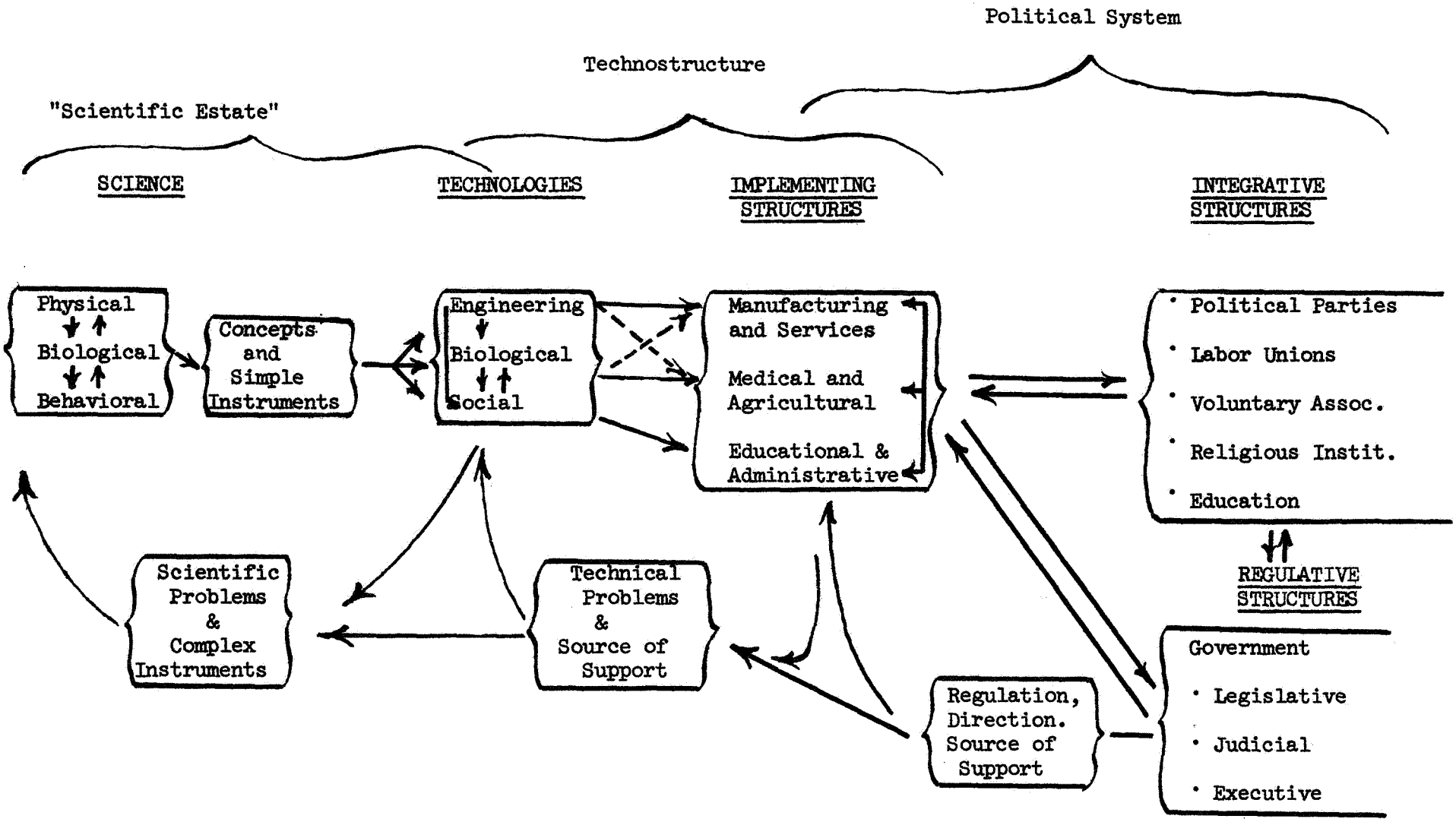
Chart I represents the distinctions and relationships between science, technology, the institutions activating technological potential, and other sectors of society. It should be clear that, in my view, science affects politics indirectly. It is the widespread technological implementation of scientific notions that is the direct lever effecting changes in social and political life.

(Chart I about here)

The remainder of the paper suggests what appears to be several very important underlying conditions stimulated by continually developing our technological potential and some of the dilemmas this has occasioned. Then, I shall propose a beginning redefinition of the problem of technologies transfer.

Chart I

RELATIONSHIPS BETWEEN SCIENCE AND POLITICS



Effects of Using Technology for Social Purpose

One of the most obvious facts about our present situation is the official commitment to using technology in solving almost all of our currently recognized social and political problems. This seems apparent whether the problems have to do with the present, or in our feeble attempts to invent the future. There is almost no end of topics enjoying the notice of technology as problem solver, urban disruption and rapid transit, the pollution of our environment, unemployment and matters of national security and international politics. Most lately we have seen technology transferred in attempts to contain dissent on campuses. Distinctions between types of crowd control gas, helicopter armament, flak jackets and other military transfers are now known to many faculty and students.

I would argue that we think first of technical solutions to our problems, only afterward addressing changes in political attitude or social arrangement.[2] In a sense we attempt short range technical solutions hoping that fundamental social and political relationships will not change. We have little or no awareness of the fundamental changes necessarily wrought by our current use of technical solutions to social problems.[3]

I should like to note three basic changes resulting from increasingly technicized solutions to economic and political problems and then explore two of their major consequences.

1. We have vastly increased our capacity to "control" physical conditions. This is paralleled by a less dramatic capacity to control

organizational and economic conditions as well. It has not, however, increased our control over social and political events.

2. The organizational systems, both in government and industry, needed to activate technical potential increases the overall complexity within and among economic, political and social institutions.[4] Each successive stage of development for a particular technology increases the organizational and financial requirements to activate it at all. Such spreading organizational requirements breaks the bounds of a single organization's resources and demands linking organizations together in tightening webs of interdependence. This faces government particularly with the problems of growing interdependence within an expanding system of technical implementation. For example, increasingly complex systems appear to have a decreasing flexibility to adapt to new conditions in the environment.

3. As a result of increases in capacity and complexity there is a sense of increasing overall uncertainty. We are increasing our capacity to control, particularly in areas new to us, e.g., atomic power and biological technology, in the process building vastly complex organizational arrangements. Accompanying this there is a growing sense that if things get out of control the consequences are likely to be disastrous and irreversible. This has resulted in a response to increase our planning efforts somehow to avoid the consequences of unknown action.[5] (This is a more fundamental problem, for there is probably a basic limitation to planning in increasingly complex situations. One simply cannot know enough in the face of complexity...even with computers.)

In sum, the combination of these conditions -- increasing capacity, complexity, and uncertainty -- confront the organization of government at local, state and national levels with a decreasing ability to know the consequences of their actions. What are some of the consequences of these conditions for political values and the administration of public affairs?

Technology and Political Values -- Briefly, increases in technical capacity and uncertainty of effects tends to increase a sense of social, political and psychological uncertainty experienced by the public about the "proper" ends of government. There is a loud insistence that government take on goals and actions extending well beyond the traditional economic and social order functions of government. The argument runs like this. For the past twenty years we have been witness to an astonishing series of technological spectaculars exceeding limits in both massive size and microscopic dimension, feats of speed and alteration of biological materials. The futurists are predicting even more radical capabilities in the next twenty to thirty years.[6] There seems to be no question that this has greatly increased our sense of the possible. Past limits thought to be more or less absolute, that is, absolute barriers not possible to breach, no longer appear to hold. From all indications a sense of enormous possibility is strongest among younger groups maturing after World War II. Theirs has been a life-time of limit breaking witness. For them most things seem possible -- vast horror or great happiness, suffocating repression or new freedom. The only operative limit is one of will, in our case political will. Greatly increased capacity to alter the world puts us in a position to choose actions of many new sorts. Great good

could be accomplished if we had the political will to turn our economic and social resources to realizing the classic values of American ideology. Many of the young believe this and it is true in part. We do have enormous resources which very likely will be expanding in the future. In many situations it is a matter of political will. To retreat into the refuge of political cross pressure and apparent paralysis, pleading that elected representatives and the public-at-large will smite public executives down if they attempted to turn our capacities toward realizing these values is to re-enforce the view that we do not have the will to use technology in the service of man. Rather it remains in the service of a few men or limited strata of society.

As technological potential is recognized as a force changing political and social conditions, we can expect growing demands to be placed on the institutions that activate this potential. Demands that it be used to create conditions more meaningful to individual and community experience. At the same time, the past conditions supporting older definitions of political and social value no longer are nearly as strong as in the past. When social and economic conditions no longer support value orientations, we can expect priorities to change and older values to be displaced by ones speaking to present conditions.[7]

Our scheme of political values is under attack by the conditions we have created on the backs of technology and science. The value of local government is questioned in the face of weak capacity to implement technical solutions to problems of regional scope. Clear separation of public from private organizations is less sensible in the face of often almost

organic symbiosis in the defense and space efforts. Peaceful dissent is now questioned in the face of organizational muscle-boundness and ineffectiveness.

In sum, the conditions underlying many of the traditional and cherished values of American politics are no longer sharp and clear to many, many people. Confusion is on the rise. In a profound sense, this makes even defining what the problems are a very difficult matter. This is an age of information systems where problem definition is stressed; and what I am saying is that even if we are convinced that problems are presently defined inappropriately, it is no easy matter to define them differently. In short, basic categories of public discourse are losing their relationship to events about us, the values of the American public are quite unsettled.

This presents us with the first dilemma discussed in this paper and puts us squarely between those two equally unsatisfactory solutions that is the definition of that term. We are forced to choose between either valuing technological solutions to national urban problems or maintaining quite deeply held social and political values defining what many people mean by democracy. Let me draw the choice more sharply. It is a choice between maintaining our value of technology and changing our basic conceptions of social and political values, or maintaining social-political values and reducing our enthusiasm for technical solutions.

Technology and the Organizations of Public Affairs -- Of the three conditions noted above, increased complexity and interdependence is of most importance in the actual operation of public organizations. The skein of relationships between governmental agencies within the executive and between these agencies and various segments of the industrial and academic communities greatly increases the interdependences within the

technical-economic system built up to activate technological potential. Through the medium of the grant and contract system we see a new pattern of Federalism emerging, one that is becoming more widely recognized by all levels of government. There is also a near revolution in the way we think about administration and organization. Organizational research has grown at an astonishing rate in the past decade signalling our uneasiness with past conceptions of bureaucracy as they are applied to the present.[8] (Certainly in the future, organizational forms are very likely to be almost unimaginably different from the familiar and irritating images of hierarchical structure most of us carry about in our heads.)

Both the increased technical character of internal administrative processes and the tightening interdependent relationships between organizations prompts the introduction of professionals of various sorts into public organizations. These men come in the guises of engineers, physician-administrators, lawyers, systems analysts and a number of other roles based on extended education or training in technically based subject matter. In a sense, we can think of professionals as uncertainty reduction devices. As they bring more or less well formulated and organized segments of information into organizations they are depended upon to sort out and provide order to great sectors of ambiguous and confusing information confronting public executives. We depend upon professionals to reduce our uncertainty about the consequences of organizational action, proposed changes in internal processes, etc.[9] In fact, if professionals do not reduce our uncertainty at least within their range of technical specialization we think seriously of getting a professional who

will. (Parenthetically, for many of us who work with professionals and are sometimes treated as though we had some bit of professional knowledge to contribute, there is the haunting suspicion that the reduction of uncertainty experienced by executives who rely on professionals is more psychological than actual.)

As these relationships of interdependence and professionalization increase within administrative organization, traditional patterns of hierarchical authority structure become more and more burdensome and begin to break down.[10] Familiar strategies of specifying procedures in detail regarding what is to be done and how it should be carried on reduce the adaptability of the organization. Controversies in the R and D industry about how best to coordinate the work of technical professionals is symptomatic of these problems. We have also seen quite recently, growing discussions of decentralization and participatory management in general.[11] Signals are going out that our present structure of organization cannot contain the present conditions of professionalization and interdependence.

The key relationship of control in organizations is called into question by conditions of complexity. The assumption of centralized control is that the person(s) held legally or organizationally responsible can determine when a subordinate's action is wrong and specify how to correct it. When conditions in the organization are such that this assumption cannot be met, traditional patterns of authority break down. Increases in technical complexity and professionalization are the two most important internal conditions eroding the necessary conditions of control.

If the confounding problem of a hostile, and unpredictable clientele and organizational environment is also encountered, control without continuous consultation is virtually impossible for sustained periods of time.[12] If continuous consultation is carried on, what is the meaning of centralized control? Organizational processes required to activate technical potential change internal and interorganizational relationships so much that traditional notions of accountability and public control are no longer viable. Familiar patterns of authority become positively harmful for mission accomplishment and there is likely to be a great upheaval within public organizations as these patterns are altered.

The second dilemma, then, is as follows. We seem to be forced to choose between increasing our levels of technical capacity or maintaining our relatively loose pattern of competing institutions, each having relatively tight internal control processes. Putting it another way, either we continue to increase and realize our technical potential and thus draw more tightly the interdependencies of government, industry and the university or maintain a relatively loose cluster of competing institutions and reduce our commitment to technology as a path to problem solutions.

Summing up thus far, the effects of increased technical capacity, organizational complexity and interdependence, and the growing sense of social and political uncertainty results in a situation where familiar values and ways of understanding our experience have an increasingly spurious character. The experiences we have do not seem to fit our current notions of how political or organizational dynamics work, and there is a lowered sense of predictiveness about our national and social

life. Events seem often out of control, and many seem beyond explanation. I suspect this lowered sense of relative predictability in day-to-day affairs is experienced by many Americans at all levels of social class and political persuasion. In the face of this kind of mass uncertainty and confusion, problems of public policy with regard to technology are enormously difficult. It appears to put us into a kind of policy cul-de-sac where we are faced with either continuing the disruption of the familiar and the erosion of important values or suffering a decline of national technological capacity.

I submit that these dilemmas are real ones...if we continue to view technology as we have in the past. If we continue to think in terms of adapting our institutions and lives to technology, monolithic and ongoing, we are indeed in for a dismal future. In the past, technological solutions have largely been developed in terms of two major criteria: can it do the job in the short run, i.e., shape the world to dam water, destroy enemy bunkers, increase production, move supplies or people faster, and can it do the job cheaply. The primary criteria is technical, i.e., will it accomplish the desired physical or organizational alteration, the secondary criteria is one of economic feasibility. In some cases, other kinds of values are also of explicit interest, as in the case of national security. There is also some indication that we are more conscious about social values in the current spat of poverty legislation, etc.

Altering our perspective about technology seems to be particularly necessary in discussions of technological transfer as partial solutions to social problems in the urban setting. I shall return to this a bit later; first, let me turn to the city as the object of technological solutions.

Technological Transfer and the City

There are a number of summaries outlining the extent technology is already used in cities. In a sense, we do not need more transfer of technology, we need different technological transfer or development. Various types of technological applications to urban problems are much discussed, and I shall not review them here.[13] Rather I should like to discuss briefly some of the implications of the conditions and dilemmas already noted for policy considerations regarding the use of technology in the solution of urban problems.

The technologies of engineering, medicine, and the more primitive methods of social engineering are powerfully shaping the social and political context of urban life. We know they have a direct relationship to the quality of life in cities. However, how much do we know about the social and psychological consequences of different technical developments, particularly on a large scale? Almost nothing! We sense that different types of technological solutions to the same immediate problem are likely to have different political or psychological effects. But our amount of information about how this occurs is almost nil.

We implement technologies willy-nilly, increasing the capacity of our organizations, increasing their complexity and interdependence, and our uncertainty about the effects of planned change in all areas of life. We do so with a kind of concerned bravado suggesting we know what we are doing. To assume, however, that we know what will occur as a consequence of this or that technical change is most short sighted and probably wrong. Do we have a clear idea of the different consequences of alternative

freeway routing compared, say to free bussing to and from ghetto areas, or the changes likely to follow from improved health care services to a deprived area? I think not, though we act as though we did. In a sense, we are busy creating our own dilemmas, in a kind of naive and mindless way.

There are, close at hand, a number of apologists for one way of looking at problems which is advertised as a path to better decision-making and problem solution. We shall continue to hear a great deal about systems analysis (sometimes called "Program planning budget systems" -- PPBS -- in government circles).[14] As you know, systems analysis is essentially a call to examine all relevant relationships concerning a problem setting, the goals of the participants, etc. Very probably systematic study of any problem, ferretting out the interconnections among different facets of the problem will help. This does provide a framework for indicating what types of information are needed and collating it in sensible ways with regard to particular goals. However, the heart of this technology-to-coordinate-technologies requires that we know what demands to place upon the analysis, the technologists. Almost by definition we are brought very close to the realm of political and social philosophy, for we are driven to consider our vision of possible futures, futures we now may be able to invent.

As we move to transfer the systems technology from the defense and space industries into the maw of city government, what can the public official and citizen expect to gain, what are the costs, and what demands ought we make on our analysts?

The gains and costs of systems analysis -- There are at least three positive aspects of systems analysis. Almost certainly city officials can expect better problem analysis both in scope and in depth than has occurred in the past. This is especially true if the problems attacked are those of primary importance to the urban communities. There will also be an increase in our sense of certainty about the effects of decisions made concerning these problems. If the conceptual understanding of the analysts are weak, this is quite likely to be short lived and somewhat illusory. Finally, leaders can expect to have an increasingly powerful political weapon based on deference to expertise and appeal to technical authority. One suspects that this is already true in many segments of urban government; for example, city managers defer almost automatically to the presumed expertise of city engineers, police chiefs, etc.

Balancing the gains of systems analysis are several negative or cost factors that ride along with its introduction. Leaders give up a measure of control over what kinds of questions will be asked regarding the definition of the problem. If technically trained people are to be called in, they must be party to how the general problem is defined. This is quite likely to be required for experts to study the problem effectively. If they cannot specify the kind of information they believe to be critical to solving the problem, their particular talents may be only incidentally worth entertaining. Without data about a problem based on the expert's "cause-effects beliefs" about its roots, a person's expertness cannot be devoted to a particular situation.

If the experts are allowed to specify the criteria for problem solution, i.e., contribute to the definition of when the problem is solved, leaders may also find that this demands increased precision in defining important values. When this is done with care in public, it often has the effect of stripping away political and/or administrative vagueness which acts as a cover for latent tensions and conflict. It leads to clearer communication of the conflicting values of political actors and heats up submerged political or administrative issues. Finally, leaders can expect that, as larger sums of money are devoted to systems analysis, pressures will increase either to implement the solutions to problems generated by systems analysts or to stop appropriating money for these studies. How often can a mayor or legislature deny the recommendations of, say, private analysis contracted to do studies, when large sums have been spent on them? As an example of this, the politics of the California State studies of several social problems done by the aerospace industry is most instructive.[15]

In effect, introducing technical professionals into the policy definition and solution process increases the overall quality of analysis; at the same time it is reducing the degree of control over that process by public officials or informed citizens. We have seen a general decline in popular control over both the problems to examine and the types of programs offered as solutions. If you will, this is a third dilemma occasioned by increasingly complex and unknowable sets or problems.

The matter of criteria specification -- When any application of systematic analysis and/or technical development is entertained as an aid

in coming to grips with urban or national problems, perhaps its most crucial aspect is the specification of demands on the agency or private contractor who will be designing and implementing the technology. Whether we use the technology-of-technological-coordination (systems analysis) or a particular hard technology, the way we understand it, i.e., our perspective about technology, is very important. As technical capacity increases we are freed from past physical and economic constraints, we can imagine many new and untried futures, futures which in a more direct sense we can invent. Whether or not we become captive of an apparently deterministic technology, depends upon our understanding of technological processes and our philosophical wits. It is time to alter our perspective of technology and turn it more directly to shaping a future based on a clear declaration of desirable future values.

Technology in a New View

I have a strong suspicion that information about the second or third order effects of various technological alternatives is almost never a part of the demands placed on the analysis of technical possibilities. Furthermore, there is almost never a demand for a clear demonstration of the linkages between different technical solutions and changes in the character of social life, at least not much past the most immediate context of the specific problem.

This is due, I would argue, to the way we think about technology... as a kind of force available to us on its terms.[16] The rhetoric of the day is filled with clues to this perspective. "We must adapt to technology." "Change our values and institutions to better use technology." There is

a large element of truth to these sentiments, if we think of technology operating solely within its own law-like dynamics; particularly if we think there is little alternative but to accept what the technologists assert is the "one best way."

Certainly massive implementation of technological potential has drastically changed our social and political landscape. And it appears to many that there is no way of escaping the erosive effect of technology upon social life and individual experience. We have, as a consequence, scarcely under the surface of our youth culture a kind of neo-Luddite revolt against the pernicious aspects of technological processes. I do not think this is necessary or desirable in order to overcome many clearly dehumanizing effects of numerous technologies.

There is nothing inherent in the structure of these technologies, the physical and biological laws upon which they are based, or the institutions associated with them, that should leave us awestruck and submissive in the face of them. I suspect that we have a limited view of what can be possible through the creative use of technologies...in the pursuit of humane as well as economic values. But this will not occur until we have the resolve to lay upon the men who design and carry out technological change a range of criteria we simply have not had the wits to demand. In our efforts to use technologies in the solution to urban and national problems, we must come to understand that technologies can be used to serve social and psychological values, as well as economic and security needs. The interchange between technological and social institutions should be one of mutual adaptation in which the reciprocal relationships are a much more recognized requirement.

(Table I about here)

Table I presents a way of visualizing, in general, the range of values affected by technological systems (save perhaps aesthetic ones). Alternative technological solutions to the same problem could be arrayed in terms of the probabilities they would re-enforce and contribute to a number of conditions we judged critical to national and urban life. I noted above that the first two values are generally the dominant ones for most considerations of technical solutions, as suggested in technical alternative 1 (T_1) with other value conditions being ignored. This was characteristic of most national decisions in Pre-World War II days. Beginning with the Cold War, political values, especially national security concerns, entered into considerations more explicitly, and technical alternatives were evaluated on the basis of their probability of satisfying political, economic and task performance criteria. More recently, transportation and poverty programs appear to include some emphasis on social and psychological values as well as the others. It strikes me that there are few large-scale problems to which technological capacities are turned that do not, at least secondarily, alter political, social and psychological experiences of many people involved in their solution. To the degree this is the case (and we do not yet know how even remotely to judge this), it seems only rational that we develop a way of assessing technologies returning a much better notion of the probable effects of implementing various alternatives in increasing the development of normatively desired conditions.

If this is to happen, government agencies seriously intent upon technology transfer and/or development, must place stipulations upon

Table I

Value Criteria for Technological Assessment

Illustrative Probabilities of Achieving Valued Conditions

	Technological Alternatives	Physical/ Organizational	Economic	Political Effect	Social Effect	Psychological Effect
(Pre--WW II)	T_1	1.0	1.0	[	ignored	]
(Cold War)	T_2	1.0	.8	[	ignored	]
(Transportation)	T_3	1.0	.7	.7	.2	[ignored]
(Poverty Programs)	T_4	1.0	.3	.5	.7	.3
	.	.	.	.	.	.
	.	.	.	.	.	.
	.	.	.	.	.	.
	T_n	$pr[A_n]$	$pr[E_n]$	$pr[P_n]$	$pr[S_n]$	$pr[Py_n]$

government programs and contracts let to private firms that require technologists to consider a wider range of values than has been the case in the past. However, to do this requires that public organizations develop a much sharper sense of social purpose. This means that public executives, legislators and concerned citizens cannot avoid much more self-conscious reflection on the public good, particularly in urban areas.

Conclusion

Let me conclude with an attempt to specify what I believe could be a set of general criteria for assessing technology as applied to urban and national problems. The normative premise for these criteria is the central purpose of public organization in our society. The purpose of public organization is the reduction of economic, social, and psychic suffering, and the enhancement of life opportunities for those with and outside the organization. Applying these sentiments as criteria for technological assessment means that we consider alternative technical solutions on the following criteria and that these be placed upon designers and technological advocates.

These criteria are the degree to which alternative technical solutions to the same general problem increase the probability of:

1. Optimum production and distribution of material abundance to free people from economic deprivation.
2. Political implementation of the preferred alternative, in the short run, and assuring shared political privilege in the long term.

3. Governmental decision-making becoming less centralized and of access by informed publics to those people in the decision structures who are most relevant to the problems affecting those publics.
4. Enchancing social justice for the citizenry in freeing them to decide their life pathway.
5. Individuals either carrying out the new technology or impacted by it experiencing personal growth and a sense of psychological freedom.

This is a positive way of viewing the consequences of technological change induced by government. Acting on these criteria requires technical designers to become much more than what they have been in the past, for example, merely engineers with economic skills. For most of us thinking in these terms is sufficiently unfamiliar so that it is very difficult to imagine even how to begin relating technological solutions to social or psychological conditions. And, in fact, technologists will have a great difficulty in meeting these kinds of demands.

Perhaps it will be seen more clearly by putting negative connotations on some of these criteria. We do not know how to answer questions about the contribution of technology in increasing the probability of shared social and political privilege. But we do know a good deal, at least indirectly, about how to decrease the possibility of shared privilege, centralizing organizations and tightening authority structures through the design of technical systems. We can design highly centralized systems which make it virtually impossible for participants to have much impact of decisions affecting their lives.

So little is known about the secondary and tertiary consequences of technology that even conceptualizing technology in ways that might unearth answers is a very formidable task.[17] But without a formal demand to link technology and social-psychological conditions, the effort is not likely to be made. Or if it is accomplished only upon the motivation of interested academics, the answers will be far too late to avoid remarkable upheaval. Before answers are to be found, the questions must be asked.

The requirements to increase the number and kinds of criteria laid on the developers of technology in the way I have suggested is a hard and heavy one. It strains the wits to think about technology in ways other than within the familiar economic and technical design parameters. But as we massively increase the technological character of political organizations and social structures, we are increasing the complexity and uncertainty, as well as the capacity, of our nation. We seem to do this whether we will it or not. Therefore, questions of the quality of social life within complexity and the psychological consequences of uncertainty fall squarely in the laps of technologists and government officials, students of public organization and informed citizens. This is to say that these problems fall squarely in your lap, for anyone reading this will surely be one or all of those people confronted with the assessment of technology. To flee from taking up the problem, is to stand paralyzed and awestruck in the face of mindless technology.

Footnotes

* A revision of a paper presented to the Technology Transfer Conference, Division of Civic Affairs, Texas Christian University, May 29, 1969, and the International City Managers' Association-Brookings Institution, Urban Policy Seminar, Alternative Futures for the American City, June 9, 1969.

1. The clearest delineation between these two types of activities are exemplified in H.W. Bode, "Reflections on the Relationship Between Science and Technology," in National Academy of Science, Basic Research and National Goals (Washington, D.C.: Report to the Committee on Science and Astronautics, U.S. House of Representatives, 1965), pp. 41-76; and D.K. Price, The Scientific Estate (Cambridge: Harvard University Press, 1965) in his discussion of the differences between scientists and professionals.

2. For a review of the literature related to this issue in the application of technology to cities, see J.D. Carroll, "Science and the City: The Question of Authority," Science, 163 (February 28, 1969), pp. 902-911.

3. Though there is some literature calling attention to fundamental change, there is little detailed examination of it. Several attempts to address this question at a high level of generality are J. Ellul, The Technological Society (New York: Knopf, 1964); J.K. Galbraith, The New Industrial State (Boston: Houghton Mifflin, 1967); and the work of Don Michael, esp. Cybernation: The Silent Conquest (Santa Barbara: Center for the Study of Democratic Institutions, 1962), The Next Generation (New York: Vintage, 1964), and "Some Speculations on the Social Impact of Technology,"

in D. Morse and A.W. Warner, eds., Technological Innovation and Society (New York: Columbia Press, 1966), pp. 118-152.

4. Both Ellul and Galbraith assert this relationship though do not explicate it. J.D. Thompson, Organizations in Action (New York: McGraw-Hill, 1967), develops elements of this theme in its implication for complex organizations.

5. Again Galbraith, op cit., comments extensively on the tendencies for this within the "mature corporation." See also discussions of planning in A.A. Altshuler, The City Planning Process: A Political Analysis (Ithaca: Cornell University Press, 1965).

6. For an extensive review of projections, see M.M. Webber, "Planning in an Environment of Change: Part I and Part II," The Town Planning Review, 39 (October, 1968, and January, 1969), pp. 179-195, 277-295; W. Khan and A.J. Weiner, The Year 2000 (New York: MacMillan, 1967) and "Toward the Year 2000," Daedalus, 93 (Summer, 1967).

7. For two historical discussions of this, see L. White, Jr., Medieval Technology and Social Change (New York: Oxford University Press, 1962), esp. Ch. 1; and R.L. Heilbroner, The Limits of American Capitalism (New York: Harper and Row, 1965), esp. Part II. There are a number of contemporary discussions related to youth culture, etc., which document this in our day. For a general discussion of the relationship between social conditions of values and reality constructs, see P.L. Berger and T. Luckman, The Social Construction of Reality (Garden City, N.J.: Doubleday, 1966).

8. For example see the several attempts to present in a single volume a wide range of organizational theoretic materials. The best known is, of course, J.G. March, ed., Handbook of Organizations (Chicago: Rand McNally,

1965); the changes in form and substance over the past decade can be seen in M. Haire, ed., Modern Organization Theory (New York: Wiley, 1959); W.W. Cooper, et al, eds., New Perspectives on Organization Research (New York: Wiley, 1964); and V.H. Vroom, ed., Methods of Organizational Research (Pittsburgh: University of Pittsburgh Press, 1967). See also T. La Porte, "The Recovery of Relevance in the Study of Public Organizations," in F. Marini, ed., The New Public Administration? (Syracuse: Syracuse University Press, 1970).

9. See H.A. Simon, "The Changing Theory and Practices of Public Administration," in I. de S. Pool, ed., Contemporary Political Science: Toward Empirical Theory (New York: McGraw-Hill, 1967), ch. 4, for an interesting discussion of the use of professionals as predictable means for reducing uncertainty.

10. Thompson, op. cit.; S. Marcson, The Scientist in American Industry (New York: Harpers, 1961); W. Kornhauser, Scientists in Industry: Conflict and Accommodations (Berkeley: University of California Press, 1962); T. La Porte, "Conditions or Strain and Accommodation in Industrial Research Laboratories," Administrative Science Quarterly, X (June, 1965), pp. 21-38.

11. See, for example, the issue of the Public Administration Review devoted to this topic, "Alienation, Decentralization, and Participation," (January-February, 1969).

12. Thompson, op. cit.; F.E. Emery and E.L. Trist, "The Causal Texture of Organizational Environment," Human Relations, 18 (November, 1965), pp. 21-32; and R.P. Biller, "Some Implication of Adaptation for Organizational and Political Development," in F. Marini, op. cit.

13. Webber, op. cit.; J. Carroll, op. cit.; see also "The City Meets the Space Age," The Architectural Forum, 126 (January-February, 1967), 60-63, 140-143; and N. Siegal, "Electronics and the Urban Crisis," IEEE, Spectrum, (May, 1968), pp. 71-77.

14. For two summaries of application and critique of PPB see the two Symposia appearing in the Public Administration Review, 26 (December, 1966), "Planning-Programming-Budgeting System: A Symposium," and 29 (March-April, 1969), "Planning-Programming-Budgeting System Reexamined: Development, Analysis and Criticism."

15. See, for example, Space General Corporation, "Prevention and Control of Crime and Delinquency," Final Report, 1968; and TRW Systems Corporation, "California Land Use Information System," Final Report, 1968. Also I.R. Haas, "Social Significance of Technological Advance," Internal Working Paper No. 67, Space Sciences Laboratory, University of California, Berkeley, June 1967.

16. Perhaps the foremost critic of this view is J. Ellul, op. cit. Summarizing both the advocates and critics of technological society, see V.C. Furkiss, Technological Man: The Myth and The Reality (New York: George Braziller, 1969), esp. chaps. 3 and 4.

17. Only a few men have tried, see Thompson, op. cit., and C. Perrow, "A Framework for the Comparative Analysis of Organization," American Sociological Review, 32 (April, 1967), pp. 194-208.